

Repeat Percutaneous Vertebroplasty at Cemented Vertebra with Fluid Sign and Recurrent Pain

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Summary

Six patients (three females and three males) were referred from their clinicians for evaluation with complaints of recurrent pain. A follow-up MRI showed fluid at the cemented vertebral bodies. Repeat percutaneous vertebroplasty (PV) was performed in these six patients at the cemented vertebrae. Pain scores, mobility scores, and spine MRIs before the 1st PV, prior to the repeat PV, and 1 and 3 months after the repeat PV were obtained. One month after the repeat PV, the six patients had a mean pain score reduction of 6.2 points and a mean postoperative pain level reduction of 2.8 points. Four of the six patients demonstrated an improvement in mobility with a 1.7 point mean decrease one month after the repeat PV. There was decreased fluid and bone marrow edema in four of the six patients on the follow-up MRIs one and three months after the repeat PV. Repeat PV at cemented vertebrae with fluid signs may offer therapeutic benefits for recurrent pain.

Introduction

Percutaneous vertebroplasty (PV) has become a widely accepted treatment for patients with painful compression fractures. The procedure results in good pain relief in most patients¹. However, recurrent back pain after PV is not uncommon². Recurrent pain arising from the previously treated levels has been re-

ported²⁻⁵. Two reported cases with recurrent pain^{3,4} showed signs of fluid in the treated bodies on follow-up imaging. The exact clinical impact of the fluid re-accumulation is not clear. It may be a sign of failed PV, which is intended to provide internal stabilization and facilitate healing⁶. In our practice, a small group of patients suffer from recurrent back pain with signs of fluid on follow-up MRI. Treatment of patients with pain at the cemented vertebrae include corpectomy with anterior fusion^{3,5}, and repeat PV^{2,4}. However, surgery may be not suitable for some patients due to old age or poor physical condition.

The purpose of this study was to evaluate the therapeutic effect of repeat PV for recurrent pain resulting from cemented vertebrae with fluid reaccumulation. The clinical outcome of repeat PV was correlated with the follow-up MR image findings.

Materials and Methods

Patient population

Between January 2005 and March 2006, 103 patients underwent PV in our department. Among the 103 patients, six patients were referred from clinicians with recurrent pain after a previous PV. The initial PV of the six patients was performed without any complications. All six patients had significant pain relief on the day 1 postoperative follow-up. When these six patients complained of recurrent pain in the

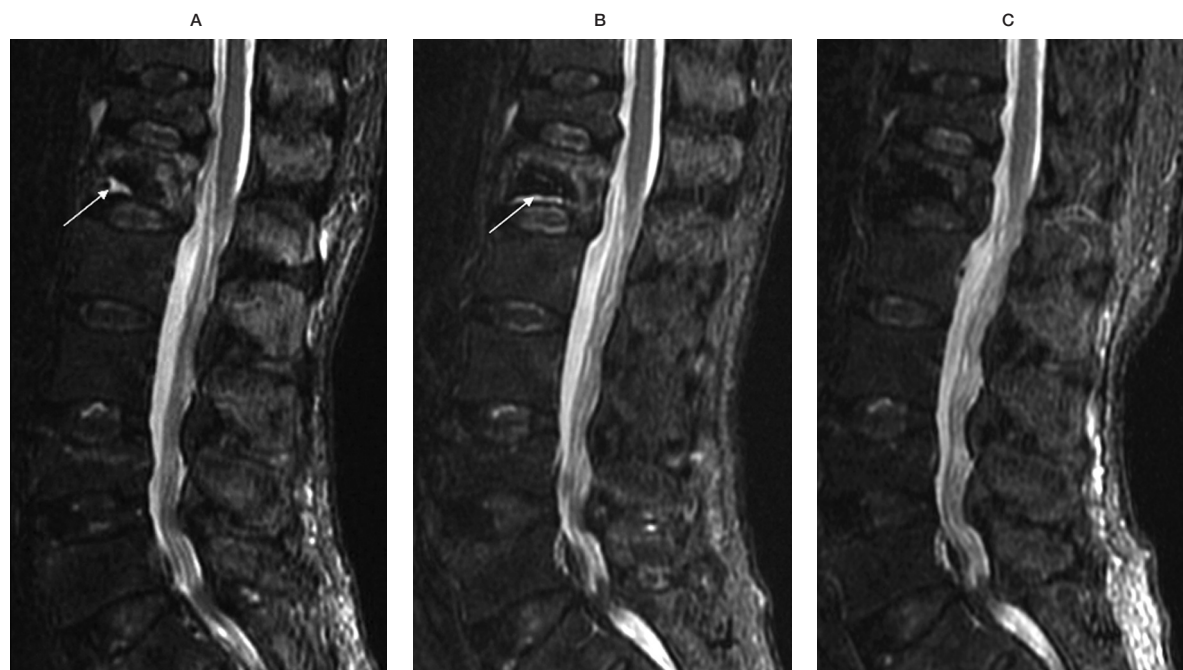


Figure 1 (A) A 78-year-old woman had severe back pain after falling down. This STIR image showed a L1 compression fracture with bone marrow edema and a vacuum cleft (white arrow). After the initial percutaneous vertebroplasty (PV), the woman had significant pain relief on the day 1 postoperative follow-up and returned home. (B) About 1 month after the initial PV, the patient had severe recurrent back pain. The follow-up STIR image showed persistent bone marrow edema and a small amount of fluid collection (white arrow) in the interface between the cement and residual bone. (C) After repeat PV, the 3 month follow-up MRI showed resolution of the bone marrow edema in the residual bone. There was no fluid collection in the interface between the cement and residual bone. The patient had significant pain relief and improvement of mobility (pain score, 10→0; mobility score, 4→0).

outpatient department, follow-up MR studies were performed and the images of all six patients showed fluid signs at the previously treated levels. There was no other explanation for the pain in the other four patients except recurrence at the previously treated levels. The back pain radiated to one side or the bilateral gluteal regions if the previously treated levels were at T12 and L1. These patients all suffered from moderate-to-severe back pain when sitting up from a lying position or after walking. After informed consent was signed, repeat PV at the previously treated vertebral levels was performed in these six patients.

Clinical follow-up

Before PV, a verbal numeric rating scale (VNRS⁷) of pain and mobility scales (5-point: 0, walking without assistance; 1, walking with assistance; 2, wheelchair bound; 3, restricted to sitting in bed; and 4, restricted to lying flat in bed) were recorded⁸. The VNRS of pain uses 0 to represent no pain and 10 to represent the most severe pain ever experienced. The VNRS and mobility scores were also recorded at the

time just before the patients underwent the 2nd PV, and one and three months after the 2nd PV.

The inter-procedural period was the interval between the 1st and 2nd PV. During the interval, one patient received a S-I joint injection 2 weeks after the 1st PV. The chief complaint of this patient was pain localized to the right gluteal region. No other patients received invasive procedures to alleviate their pain.

Fluid sign

Fluid sign in the treated bodies is defined as well-demarcated, linear or large areas of T2 prolongation that is isointense to CSF on T2WI around the cement in the treated bodies⁹.

The procedure of the 2nd PV

We attempted to put an 11- or 13-gauge bone marrow biopsy needle into the interface between the cement and residual bone of the previously treated vertebral bodies. Fluid in the bone-cement interface was aspirated from all six patients.

The gross appearance of the fluid was yellowish, tinged with some blood. Though there

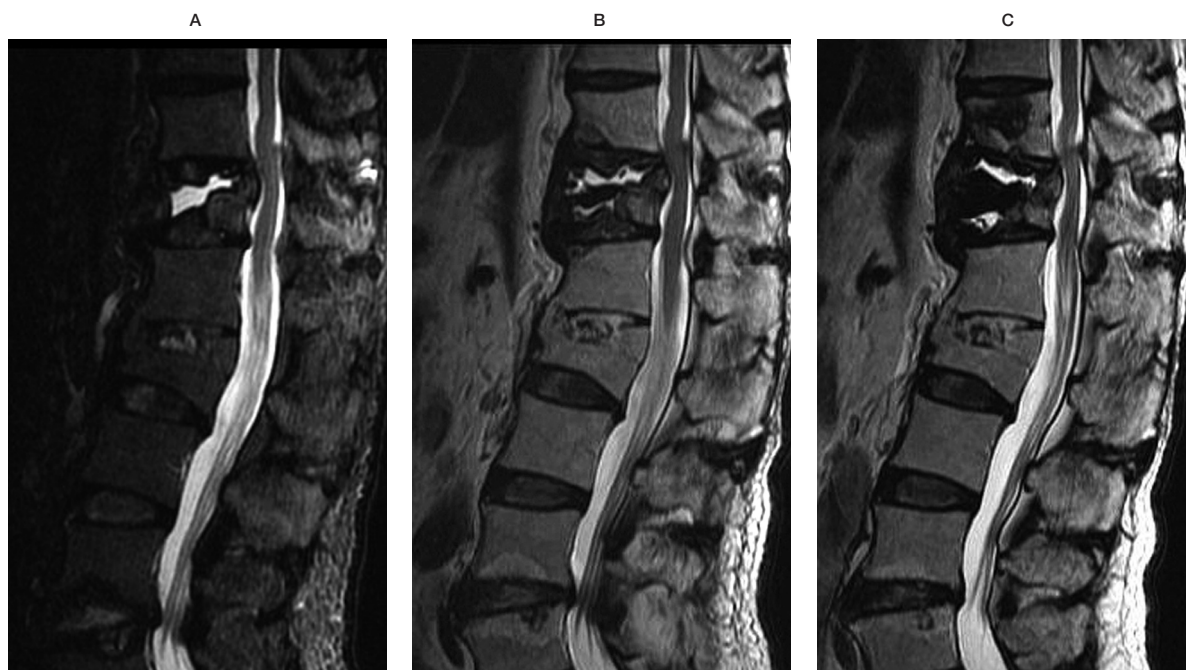


Figure 2 (A) A 72-year-old man had severe back pain. The STIR image showed a fluid-filled cavity in the T12 vertebral body. The bone marrow of the residual bone did not have an increased signal intensity compared to the adjacent level. He underwent percutaneous vertebroplasty (PV) and had significant pain relief at the 1 day follow-up. (B) About 36 days after the procedure, he visited the outpatient department and complained of pain and soreness over the bilateral gluteal regions. The follow-up T2W sagittal image showed fluid in the treated body. The bone marrow of the residual bone did not have a signal change. The T11 vertebral body was partially collapsed at the anteroinferior region. (C) The three month follow-up MRI after repeat percutaneous vertebroplasty showed persistent fluid collection in the interface.

was no clinical information suspicious of infection, the fluid was sent for bacterial culture to completely exclude infection. Considering the very low probability of infection, we proceeded with cementation without delay. The cement (Surgical Simplex P; Stryker Howmedica Osteonics, Limerick, Ireland) was injected to fill the possible incomplete filling cleft or the interface between the loosening cement and residual bone (one patient was treated with a bi-transpedicular approach and five patients were treated with a uni-transpedicular approach). For the patient with an adjacent new compression fracture, another bone marrow biopsy needle was placed, followed by bony cement injection in the adjacent fractured level.

Pre- and post-procedural imaging protocols

Before the 1st PV, all six patients received a pre-procedural spine MRI without any treatment. All six patients also received follow-up MRI studies 1 day before the repeat PV, and 1 and 3 months after the repeat PV. The MRI was performed on a 1.5T MR unit. The image protocol included sagittal T1-weighted (600-650/9-

11reFpetition time msec/echo time msec) and T2-weighted (3500-3750/100-116) spin-echo images and short inversion time inversion-recovery images (3800/38/150 inversion time msec) with a 4-mm slice thickness.

The image findings of the MRI study were analyzed. We recorded the level of the treatment, the edematous changes of the residual bone in the treated bodies, the fluid signs in the treated bodies, and the existence of a vacuum cleft, if there was a newly developed compression fracture, and if there was residual bone between the cleft and the vertebral endplate. Minimal residual bone was defined as nearly no visible trabecular bone between the cleft and the adjacent disc.

Results

The detailed information of the six patients is summarized in Table 1. The patients included three females and three males with a mean age of 77 years (range, 72-85 years). The interoperative interval between the 1st and 2nd PV ranged from seven-82 days, with a mean of 51 days.

Table 1 Summary of the six patients.

	Gender/ age/level	Chief complaints	Inter- operative interval	MS	PS	Amount of cement injected (cc)	
				*,\$,#,!	*,\$,#,!	1 st	2 nd
1	M/72/T12	Pain and soreness over the bilateral gluteal region	65	4,1,1,0	10,7,3,3	5	8
2	F/79/T12	Pain and soreness in the right gluteal region	75	1,2,0,0	8,8,0,0	2	5
3	F/78/L1	Pain in the right gluteal region	49	1,4,0,0	9,10,0,0	4	6
4	M/77/T12	Back pain	59	1,2,1,1	8,9,3,5	4	4
5	F/85/L1	Back pain	82	4,3,3,2	10,7,5,5	8	2
6	M/73/L2	Back pain	7	0,4,1,1	10,10,3,5	5	4

MS: mobility score; PS: pain score; *: pre-1st PV; \$: recurrent pain; #: 1 month post-2nd PV; !: 3 month post-2nd PV

One month after the 2nd PV, five of the six patients had a reduction of at least four points in their rating of pain, with a mean reduction of 6.2 points and a mean postoperative pain level of 2.8 points. All six patients reported impaired mobility before the 2nd PV. Four of six patients demonstrated an improvement in mobility with

a 1.7 point mean decrease one month after the 2nd PV. Three months after the 2nd PV, the mean reduction of the pain score, the mean postoperative pain level, and the mean improvement of mobility scores were 5.5, 3, and 2 points, respectively.

All six patients had a vacuum cleft with signs

Table 2 MRI analysis of the six patients.

Patient	MRI FINDINGS									
	Before the 1 st PV			At the time recurrent pain occurred			one month post-2 nd PV		three month post-2 nd PV	
	F	E	C	F	E	A	F	E	F	E
1	+	-	+	+	-	T11	+	-	+	-
2	+	+	+	+	+		-	-	-	-
3	+	+	+	+	+		-	+, decreased	-	-
4	+	+	+	+	+		-	+, decreased	-	-
5	+	+	+	+	+	T12	+	+	+	-
6	+	-	+	+	+		+, decreased	+, decreased	-	-

Fluid: (+), fluid in the vacuum cleft or interface between the cement and residual bone on MRI; (-) no fluid collection.
Edema: (+), bone marrow edema in the treated bodies; (-), no bone marrow edema in the treated bodies.
C: (+), with intravertebral cleft; (-) without intravertebral cleft. A: adjacent compression fracture.

of fluid on the MRI obtained before the 1st PV. Fluid re-accumulation in the treated bodies on the MRI obtained before the 2nd PV was also demonstrated in all six patients. There was decreased fluid and bone marrow edema in four of the six patients on the follow-up MRI 1 and 3 months after the 2nd PV (Figure 1). Persistent fluid existed in the other two patients on the follow-up MRI one and three months after the 2nd PV (Figure 2). Two patients had developed an adjacent compression fracture at the 1 month follow-up MRI after the 2nd PV. Cement was injected into the adjacent compression level in the 2nd PV. The MRI findings are summarized in Table 2.

The fluid samples of all six patients showed no growth in anaerobic and aerobic cultures.

Discussion

PV has been widely accepted as an effective and minimally invasive procedure for compression fractures. It allows remarkable and rapid pain relief in most cases. However, recurrent pain in a small group of patients has been reported to occur a short interval after PV^{2,5}.

In the follow-up of our patient group after PV, some patients complained of recurrent pain and the follow-up MRI showed fluid in the previously treated vertebral bodies. Reviewing the literature, four similar cases have been reported^{3,5}. Different terms, such as refracture with cement extrusion⁴, cement dislodgment³, and aseptic loosening⁵, have been used to describe this phenomenon after PV. This may be a sign of subsequent failure of the PV to provide internal stabilization for healing, rather than a complication after PV; it may be similar to the aseptic loosening in the cemented arthroplasties. Reviewing the literature of these patients with aseptic loosening cement, three patients were treated with corpectomy with anterior fusion^{3,5}, and one patient had a repeat PV⁴.

In this small case series, we retreated the vertebral bodies with loosening cement and followed up the therapeutic effect with image correlations.

Although the previous PV did not help the vertebral bodies heal, the clinical outcomes of all 6 patients revealed that repeat PV offered a therapeutic benefit at the previously treated level. Four of the six patients had decreased bone marrow edema and fluid on the MRI 1 month after the 2nd PV compared to the image

before the 2nd PV. These follow-up image findings were in agreement with the clinical improvement. The reasons for the loosening cement in these four patients may be explained by the shrinkage of cement during polymerization⁶, poor fracture healing from insufficient cement filling, or new fractures around the PM-MA cement^{2,4}. The repeat PV may have filled the clefts better and provided a more stable internal environment for healing in these four patients.

The MR images of another two patients did not show a decreased amount of fluid between the cement and residual bone 1 month after repeat PV. The residual bones of these two patients were only about one-fourth in the posteroinferior aspects of the treated levels. Other parts of these two treated bodies were like a fluid-filled cavity before the 1st PV, and similar to the appearance in the two reported cases^{3,4}. The injected cement was like filling a contained space. The cement may be in direct contact to the adjacent disc. We hypothesize that repeat micromotion of the cement may result in degeneration of the disc and the adjacent compression fracture. The two patients had adjacent new compression fractures on the MRI before the 2nd PV. Even though the images of these two patients did not show any improved signs, they did have some pain relief and improved mobility 1 month after repeat PV. The clinical improvements of these two patients were less than the other four patients. One of these two patients remained wheelchair-bound three months after the repeat PV and the patient complained of persistent back pain (5/10). The other patient could walk by himself, but had mild soreness and pain over the bilateral gluteal regions after walking for a short distance. The symptom was the same as before the 2nd PV, but with palliation at the three-month follow-up.

Lewis⁶ proposed that aseptic loosening of a cemented arthroplasty is a multifactorial phenomenon involving interfacial failure, bond failure, bone remodeling, and cement failure. The two different image findings after repeat PV in the bodies with aseptic loosening cement may be explained by the multifactorial phenomenon.

In the severe collapsed bodies with minimal residual bone and a fluid-filled cavity which almost contact the upper and lower disc, bone-cement interfacial failure may not be corrected

with a repeat PV. We suggest that the increased post-treatment strength or PV in the new compression fracture was probably responsible for the pain relief¹⁰.

The main limitation of this study was the small sample of patients. This makes the study lack statistically significant data.

Repeat PV in the previously treated vertebral levels with fluid may offer therapeutic benefit for recurrent pain. The follow-up MRI after repeat PV may show decreased bone marrow edema and fluid in some patients, or persistent fluid in the bodies with minimal residual bone of both the upper and lower endplates.

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